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A Study of Mechanochemical Doping of Fluoride Crystals with a Fluorite Structure by Er3+ Ions via Electron Paramagnetic Resonance Spectra

Irisova I., Rodionov A., Tayurskii D., Yusupov R.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Using electron paramagnetic resonance (EPR) spectroscopy, we have shown that, upon mechanoactivated doping of powders of compounds CaF2, SrF2, and BaF2 with Er3+ ions, impurity centers of single erbium ions with cubic symmetry are formed. Investigations of dependences of EPR spectra intensities on the particle size show that the process of mechanochemical doping with Er3+ ions proceeds differently for CaF2, SrF2, and BaF2 host matrices. In the case of CaF2, impurity centers are localized in a very thin near-surface layer of CaF2 particles, in SrF2, the impurity is distributed over the volume of particles, while, in BaF2, there is a layer of a finite thickness for which the probability of doping in the course of mechanosynthesis is very small and the impurity of the rare-earth element is localized in the core of large particles. These data can be explained assuming that the result of mechanosynthesis of particles of fluorides with a fluorite structure doped with Er3+ ions at room temperature is governed by two processes - mechanoactivated diffusion of rare-earth ions into particles and segregation of impurity ions at grain boundaries. In this case, the typical scales for compounds CaF2, SrF2, and BaF2 considerably differ from each other.

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